

REMARKS

The application now includes claims 1-7, 15-54. Claims 33-45 were previously withdrawn. Claims 8-14 are deleted herewith, thereby reducing the number of independent claims. The dependencies of claims 15-22 were amended accordingly, to depend on claim 1. Claim 23 was made dependent on claim 1, further reducing the number of independent claims, and also broadened to relate to any intrabody probe. The language of claims 23-26 was amended accordingly. In addition, claim 25 was amended for clarity as discussed below. Claim 29 was amended for clarity. Applicants submit the scope of claim is unchanged.

Independent claims 1 and 27 are amended so that the first modality is an ionizing radiation modality (broadening) and the second, structural modality is ultrasound imaging. These claims are also amended to recite that non-uniformities (e.g., of tissue) in the structural image are used for generating attenuation correction instructions. Claim 27 is also broadened by removing the act of co-registering and to apply the Examiner's suggestions re clarity.

Claims 46-54 are new. Claims 46-48 reintroduce some limitations deleted from claims 1, 8, 23 and 27. Claim 49-52 further characterize claim 1. Claim 53 is a new method claim which generalizes some aspects of claim 1 and claim 49.

It is hoped that these changes will help focus the examination process. Applicants reserve the right to reintroduce deleted subject matter in a continuation application.

Objection to the specification

The Examiner objected to the disclosure as including an embedded hyperlink or other browser-executable code. Applicants have supplied replacement paragraphs which should overcome this objection.

Objection to claim 27

The Examiner objected to claim 27 as including “by a second modality” too many times. Applicants have amended claim 27 substantially as suggested by the Examiner, taking into account the other amendments made herewith.

Claim rejection 35 USC 112

The Examiner rejected claim 25 as not having sufficient antecedent basis for the phrase “said motor”. Claim 25 has been amended to explicitly introduce the motor. No new matter was added.

Claim rejections 35 USC 103

Claims 1-3, 5-10, 12-14, 18, 22 and 27-30 are rejected over Liebig et al (US 5,672,877). Claims 4, 11 and 31 are rejected over Liebig in view of Front et al (US 6,368,331). Claims 15 and 32 are rejected over Liebig in view of Fry et al (US 4,951,653). Claims 16, 17 and 23-25 are rejected over Liebig in view of Benaron et al (US 6,246,901). Claim 19 is rejected over Liebig in view of Funda et al (US 5,572,999). Claims 20 and 21 are rejected over Liebig in view of Sieben et al (US 5,243,988). Claim 26 is rejected over Liebig in view of Benaron and Fry.

In an effort to simplify prosecution, the previous four independent claims have been shortened and combined into two claims, 1 (apparatus) and 27 (method). Similar limitations are added to both claims, namely that the structural image is an ultrasound image and that non-uniformities in the image are used for generating attenuation correction instructions. For the same reason of simplifying prosecution, applicants are not arguing every single rejection, but reserve the right to do so, if needed.

Applicants thank the Examiner for the detailed rejection of the claims and believe that the main points of the Examiner’s rejection (i.e., as applied to the independent claims and some dependent claims) may be roughly summarized as follows. Applicants hope they did not mischaracterize the Examiner’s position:

Liebig shows both attenuation correction and multi-modal imaging with registration of the images of different modes. Liebig also equates ultrasound and CT. Benaron teaches a rectal probe and combined structural and biochemical images. Other cited art is used to show particular claim limitations in the dependent claims.

Applicants respectfully submit that the Examiner misapplied the references to claim 1 and that, in fact, the claims, including the independent claims are not *prima facie* obvious in view of the cited art because the art does not include or suggest all the limitations in claim 1 and claim 27, before or after amendment. In particular, Applicants will argue that Liebig does not teach (and would not consider) using anything other than a NM (nuclear medicine) transmission image for attenuation correction. In addition, applicants believe that a person skilled in the art would not carry out the combinations suggested by the Examiner, particularly, not combine Liebig with Benaron or Sieben.

Applicants also direct the Examiner to the prosecution of somewhat different claims in a corresponding application in Europe, for which a summons for Oral proceedings was just issued. A Supplemental IDS, together with the summons for Oral proceedings and associated references, is included herewith. The amendments and arguments herein are intended to take into account the art therein as well. In particular it is noted that the art therein at least does not describe using non-uniformities in an ultrasound image to perform attenuation correction. This adds to the argument presented below, that while ultrasound in rectal imaging (for example) is well known, using such imaging to detect non-uniformities and provide attenuation correction for radiation images was not considered. Rather, the art, over many years, considered that axial tomography transmission images of gamma (or x-ray radiation) should be used. An exemplary background article is found at "http://en.wikibooks.org/wiki/Basic_Physics_of_Nuclear_Medicine/X-Ray_CT_in_Nuclear_Medicine".

Applicants will first interpret Liebig. In applicants' understanding, Liebig teaches two ideas possibly relevant to the instant application (and not necessarily new). First, that a NM-transmission image may be used for attenuation correction, and, second, that such a transmission image, being structural, can also be used for image registration with a different modality, such as CT or MRI. See Col. 10, lines 46-63.

Applicants suggest to the Examiner that Col. 4, lines 15-34 teach ONLY the using of NM-transmission images for attenuation correction of NM-emission images.

Applicants respectfully suggest that attenuation correction of any other type is not provided by the rest of the cited art.

Thus, none of the cited art suggests using a non-radiation image for generating attenuation instructions of an NM image, especially not using an ultrasound image for such instruction generation.

Applicant respectfully submit that there are three particular reasons for Liebig to use NM-transmission for attenuation correction:

(a) the attenuation of radiation at similar energies is generally similar, so by using a source with energy similar to that of the one used for emission-image, similar attenuation behavior in the two images (transmission and emission) may be expected. This allows the transmission image to be used directly as an attenuation map.

(b) a same (and thus always co-registered) detector can be used for both images.

(c) cost is reduced, as only software and an extra scanning source need to be provided.

In addition, Liebig uses an imaging modality which guarantees passing through the entire body.

Applicants notes that At col. 1, line 16, Liebig mentions ultrasound and then ignores it throughout the application, even though many other modalities are mentioned. Furthermore, Benaron, for example, also mentions ultrasound and fails to realize its potential use for attenuation correction.

In contrast to the art which did not so recognize as useful, claim 1 and claim 27 use ultrasonic imaging for attenuation instruction generation. This has several potential advantages. First, the patient is exposed to less radiation. Second, there is no need for large systems, like MRI and NM transmission imagers. Third, while ultrasound does not usually serve to image an entire cross-section of the body, for local studies, what is generally needed is the characterization of tissue between the intrabody source and the detector. Fourth, ultrasound is suitable for an “inside out” viewing.

Applicants contend that none of these potential advantages are recognized by the art, while it may be assumed that the potential disadvantages of ultrasound, namely that the penetration depth is limited and that ultrasound-tissue interaction is nothing like that of NM images, were known. In addition, in systems such as Liebig, rigidly

co-registering ultrasound imaging and NM imaging, when the NM imaging is contactless and ultrasound must maintain contact, is not a trivial task.

As noted above applicants respectfully submit that the combinations suggested by the Examiner are not reasonable. Liebig teaches a system which rotates around a patient and uses large detectors for obtaining both a transmission radiation image and an emission radiation image from outside the body. Such a system is of a size and weight several orders of magnitude larger than that of a probe like Benaron, and operates using a different principle (axial tomography). Moreover, it is not clear how Benaron would provide a transmission radiation image in his system. The light image provided in Benaron, is NOT suggested as being useful for attenuation correction of an ionizing radiation image. Similar (e.g., with respect to size and technical difficulties) arguments apply to Seiben.

Applicants also note that Benaron teaches away from using ionizing radiation imaging, for example, at Col 7, line 25. It is not clear how the reported advantages of Benaron could be achieved using a NM system, especially not one such as Liebig's.

Applicants also contend that Col. 12, lines 19-21 of Liebig do not mean "apply my ideas for any type of imaging", but rather "you can image from any direction and correlate that to an attenuation-corrected NM image that was acquired as just described". See Col. 12, lines 8-18.

The dependent claims are patentable at least by virtue of being dependent on a patentable independent claim.

The new dependent claims add additional features not found in the art. For example claim 49 relates to identifying tissue boundaries. This is not needed in the art, as the transmission image is matched pixel-to-pixel to the emission image. Similarly, there is no need in the art for tissue characterization as in claim 50.

With respect to claim 51, the art does not suggest using a 3D ultrasonic image for attenuation correction.

With respect to claim 52, Liebig would at most be considered as providing the two "devices", if at all, at same axial positions, and not mounted on an elongate element, but on a gantry.

New independent claim 53 is related to claims 1 and 49, in that boundary identifications are used to assist in image reconstruction. As noted with respect to claims 49 and 50, there is no need for such identification in Liebig.

New dependent claim 54 further distinguishes over art, for example, over imaging modalities such as CT and MRI, in that a probe is not generally contacted to a body in such modalities.

In view of the above amendments and remarks it is respectfully submitted that claims 1-7, 15-32 and 46-54 are now in condition for allowance. A prompt notice of allowance is respectfully and earnestly solicited.

Respectfully submitted,



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Enclosures:

- Petition for Extension (Three Months)
- Additional Claims Transmittal Fee
- Supplemental IDS (containing Summons for Oral Proceedings and References)